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Applicant(s): Leonard Harrison, et al Docket: 10308

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For: IMMUNOREACTIVE AND IMMUNOTHERAPEUTIC MOLECULES

Assistant Commissioner for Patents
Box PCT
Washington, DC 20231

SUBMISSION OF DECLARATION
AND POWER OF ATTORNEY

Sir:

Enclosed is a Declaration and Power of Attorney for the above application previously filed without a declaration. The requisite $130.00 surcharge for this filing is enclosed by check.

Any additional charges required in connection with this submission may be charged to Deposit Account No. 19-1013. A duplicate of this sheet is enclosed.

This submission is believed to be timely and in compliance with 37 C.F.R. §§1.51, 1.63.

Respectfully submitted,

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CERTIFICATE OF MAILING UNDER 37 C.F.R. §1.8(a)

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, DC 20231 on November 20, 1996.

Dated: November 20, 1996

Leopold Presser

92 Rec'd PCT/PTO 18 JUN 1996

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35.U.S.C. 371	ATTORNEY'S DOCKET NO. A30623 PCT USA U.S. APPLICATION NO. 08/663272

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/AU96/00085	20 FEBRUARY 1996	20 FEBRUARY 1995

TITLE OF INVENTION: IMMUNOREACTIVE AND IMMUNOTHERAPEUTIC MOLECULES

APPLICANT(S) FOR DO/EO/US: Leonard Harrison, Margo Honeyman, George Rudy, and Andrew Lew

Applicant herewith submits to the United States Designated /Elected Office (DO/EO/US) the following items and other information:

1. [x] This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. [x] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(I).
4. [ ] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [x] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [ ] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [x] has been transmitted by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [ ] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [ ] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] have been transmitted by the International Bureau
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [ ] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [x] Other items or information:
    PCT Request PCT/RO/101
    A copy of application with 4 sheets of drawings
    International Search Report

CERTIFICATE OF EXPRESS MAIL UNDER 37 C.F.R. 1.10

"Express Mail" Mailing Label No. EH560810517US. Date of Deposit June 18, 1996. I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" Service under 37 C.F.R. 1.10 on the date indicated above and is addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231.

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U.S. Application No.	International Application No. PCT/AU/96/00085	Atty Docket No. A30623 PCT USA

17. [X] The following fees are submitted:

CALCULATIONS PTO USE ONLY

Basic National Fee (37 CFR 1.492(a)(1)-(5):

Search Report has been prepared by the EPO or JPO $880.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) $680.00

No international preliminary examination fee paid to USTPO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) . $750.00

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO . . . $1010.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) . . . . . $ 94.00

ENTER APPROPRIATE BASIC FEE AMOUNT =				$1010.00	
Surcharge of $130.00 for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 C.F.R. 1.492)(e)).				$	
Claims	**Number Filed**		**Number Extra**	**Rate**	$
Total Claims	55	-20=	35	X $ 22.00	$ 770.00
Independent Claims	7	-3=	4	X $ 78.00	$ 312.00
Multiple dependent claim(s) (if applicable)				+ $250.00	$ 250.00
TOTAL OF ABOVE CALCULATIONS =				$2342.00	
Reduction by ½ for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				$1171.00	
SUBTOTAL =				$1171.00	
Processing fee of $130.00 for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$1171.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +				$	
TOTAL FEES ENCLOSED =				$1171.00	
				Amount to be: refunded	$
				charged	$

a. [X] A check in the amount of $ 1171.00 to cover the above fees is enclosed.

b. [ ] Please charge our Deposit Account No. 02-4377 in amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [x] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-4377. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

BRUMBAUGH, GRAVES, DONOHUE & RAYMOND
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SIGNATURE

NAME Ronald B. Hildreth

REGISTRATION NO. 19,498

IMMUNOREACTIVE AND IMMUNOTHERAPEUTIC MOLECULES

The present invention relates generally to molecules such as peptides, polypeptides and proteins which interact immunologically with antibodies or T-cells in subjects having pre-clinical or clinical Insulin-Dependent Diabetes Mellitus (IDDM). These molecules are preferentially immunoreactive to T-cells in subjects having pre-clinical or clinical IDDM and are useful in the development of diagnostic, therapeutic and prophylactic agents for IDDM.

Amino acid sequences are referred to herein by sequence identity numbers (SEQ ID NOs) which are defined at the end of the specification.

Throughout this specification, unless the context requires otherwise, the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element or integer or group of elements or integers, but not to the exclusion of any other element or integer or group of elements or integers.

Insulin - Dependent Diabetes Mellitus is a serious disease resulting from the destruction of insulin-secreting β - cells, probably mediated by T cells that recognise β-cell autoantigens. A major antigen implicated in T-cell mediated β-cell destruction characteristic of IDDM is glutamic acid decarboxylase (GAD), which occurs in two major isoforms, GAD 65 and GAD 67. These two isoforms have approximately 65% similarity at the amino acid sequence level. Subjects with IDDM or at high-risk of the disease show autoantibody and autoreactive T-cell responses to GAD insulin or both autoantigens. In NOD mice, an animal model for spontaneous IDDM, GAD is a dominant and early target antigen (Tisch *et al Nature 366*:72-75, 1993).

Identification of the immunodominant epitope(s) of pathogenic autoantigens involved in β-cell autoimmunity could lead to improved methods of diagnosis as well as therapeutic strategies to prevent IDDM.

In work leading up to the present invention, the inventors sought to identify immunodominant epitopes in GAD and proinsulin molecules in order to improve upon current diagnostic procedures and to further develop therapeutic and prophylactic compositions and treatment approaches for IDDM.

In accordance with the present invention, peptides were synthesised based on a thirteen amino acid region of high similarity between the sequences of human GAD 65 (amino acid residue numbers 506-518) and human proinsulin (amino acid residue numbers 24-36), which region of similarity also extends to human GAD 67 and mouse proinsulins and mouse GADs (Figure 1). The immunoreactivity of these peptides is identified in accordance with the present invention on the basis of interactivity of peripheral blood cells or T-cells obtained from the peripheral blood of subjects with pre-clinical or clinical IDDM, thereby forming the basis for a new range of diagnostic, therapeutic and prophylactic procedures for IDDM.

Accordingly, one aspect of the present invention provides a recombinant or synthetic peptide or chemical equivalents thereof of the formula:

$$X_1X_2X_3$$

wherein:

X_1 and X_3 may be the same or different and each is an amino acid sequence comprising from 0 to 40 naturally or non-naturally occurring amino acid residues; X_2 is any amino acid sequence of from 10 to 100 residues derived from, homologous to or contiguous within amino acids 506 to 518 inclusive or derivatives thereof of human GAD65 and/or amino acids 24 to 36 inclusive or derivatives thereof of human proinsulin; and wherein said peptide molecule is capable of reacting with T cells and modifying T-cell function when incubated with cells from subjects having pre-clinical or clinical Insulin-Dependent Diabetes Mellitus (IDDM). Preferred cells include but

are not limited to peripheral blood mononuclear cells (PBMCs), anticoagulated whole blood and tissue biopsy cells.

Reference to a "peptide" includes reference to a polypeptide or protein or parts thereof.

In a preferred embodiment X_2 comprises not less than about 10 and not greater than about 50, amino acid residues, more preferably not less than about 10 and not greater than about 30 amino acid residues and even more preferably not less than about 10 and not greater than about 15.

In a particularly preferred embodiment X_2 has either of the following amino acid sequences:

F F Y T P K T R R E A E D [SEQ ID NO:1]; or

F W Y I P P S L R T L E D [SEQ ID NO:2].

According to this preferred embodiment, there is provided a recombinant or synthetic peptide or chemical equivalent thereof comprising the sequence:

$$X_1X_2X_3$$

wherein

X_1 and X_2 may be the same or different and each is an amino acid sequence comprising from 0 to 15 naturally or non-naturally occurring amino acid residues;

X_2 is selected from FFYTPKTRREAED and FWYIPPSLRTLED or a derivative or chemical equivalent thereof and wherein said peptide is capable of reacting with T cells and modifying T-cell function when incubated with cells from subjects with pre-clinical or clinical IDDM and determining reactivity by an appropriate assay. Preferred cells include but are not limited PBMCs, anti-coagulated whole blood or tissue biopsy cells and determining reactivity by an appropriate assay.

The peptides of the present invention may be prepared by recombinant or chemically synthetic means. According to a preferred aspect of the present invention, there is provided a recombinant peptide which is preferentially immunologically reactive with

T-cells from individuals with clinical or pre-clinical IDDM, which is prepared by the expression of a host cell transformed with a cassette coding for the peptide sequences of the present invention. The peptide may be fused to another peptide, polypeptide or protein. Alternatively, the peptide may be prepared by chemical synthetic techniques, such as by the Merrifield solid-phase synthesis procedure. The synthetic or recombinant peptide may or may not retain GAD activity or proinsulin activity. Furthermore, although synthetic peptides of the formula given above represent a preferred embodiment, the present invention also extends to biologically pure preparations of the naturally occurring peptides or fragments thereof. By "biologically pure" is meant a preparation comprising at least about 60%, preferably at least about 70%, more preferably at least about 80% and still more preferably at least about 90% or greater as determined by weight, activity or other suitable means.

By "pre-clinical IDDM" as used herein means those subjects who may or may not be first degree relatives of someone with IDDM who have genetic and/or immune markers of pancreatic islet (β) cell autoimmunity. By "immune markers" is meant amongst other parameters known to those in the art to include circulating antibodies and/or T-cells reactive with islet (β) cell autoantigens.

By "derivatives" as used herein is taken to include any single or multiple amino acid substitution, deletion and/or addition relative to the naturally occurring amino acid sequence in the native molecule from which the peptide is derived including any single or multiple substitution, deletion and/or addition of other molecules associated with the peptide, including carbohydrate, lipid and/or other proteinacious moieties. Such derivatives, therefore, include glycosylated or non-glycosylated forms or molecules with altered glycosylation patterns.

By the term "reacting with T cells and modifying T-cell function" as used herein is taken to include T-cell activation, T-cell inactivation and/or T-cell death.

The present invention also covers chemical analogues of the subject peptides which include, but is not limited to, modifications to side chains, incorporation of unnatural amino acids and/or their derivatives, during peptide synthesis and the use of cross-linkers and other methods which impose conformational constraints on the peptides or their analogues.

Examples of side chain modifications contemplated by the present invention include modifications of amino groups such as by reductive alkylation by reaction with an aldehyde followed by reduction with $NaBH_4$; amidination with methylacetimidate; acylation with acetic anhydride; carbamoylation of amino groups with cyanate; trinitrobenzylation of amino groups with 2, 4, 6-trinitrobenzene sulphonic acid (TNBS); acylation of amino groups with succinic anhydride and tetrahydrophthalic anhydride; and pyridoxylation of lysine with pyridoxal-5′-phosphate followed by reduction with $NaBH_4$.

The guanidine group of arginine residues may be modified by the formation of heterocyclic condensation products with reagents such as 2,3-butanedione, phenylglyoxal and glyoxal.

The carboxyl group may be modified by carbodiimide activation <u>via</u> O-acylisourea formation followed by subsequent derivitisation, for example, to a corresponding amide.

Sulphydryl groups may be modified by methods such as carboxymethylation with iodoacetic acid or iodoacetamide; performic acid oxidation to cysteic acid; formation of mixed disulphides with other thiol compounds; reaction with maleimide, maleic anhydride or other substituted maleimide; formation of mercurial derivatives using 4-chloromercuribenzoate, 4-chloromercuriphenylsulphonic acid, phenylmercury chloride, 2-chloromercuri-4-nitrophenol and other mercurials; carbamoylation with cyanate at alkaline pH.

Tryptophan residues may be modified by, for example, oxidation with N-bromosuccinimide or alkylation of the indole ring with 2-hydroxy-5-nitrobenzyl bromide or sulphenyl halides. Tyrosine residues on the other hand, may be altered by nitration with tetranitromethane to form a 3-nitrotyrosine derivative.

Modification of the imidazole ring of a histidine residue may be accomplished by alkylation with iodoacetic acid derivatives or N-carbethoxylation with diethylpyrocarbonate.

Examples of incorporating unnatural amino acids and derivatives during peptide synthesis include, but are not limited to, use of norleucine, 4-amino butyric acid, 4-amino-3-hydroxy-5-phenylpentanoic acid, 6-aminohexanoic acid, t-butylglycine, norvaline, phenylglycine, ornithine, sarcosine, 4-amino-3-hydroxy-6-methylheptanoic acid, 2-thienyl alanine and/or D-isomers of amino acids.

Crosslinkers can be used, for example, to stabilise 3D conformations, using homo-bifunctional crosslinkers such as the bifunctional imido esters having $(CH_2)_n$ spacer groups with n=1 to n=6, glutaraldehyde, N-hydroxysuccinimide esters and hetero-bifunctional reagents which usually contain an amino-reactive moiety such as N-hydroxysuccinimide and another group specific-reactive moiety such as maleimido or dithio moiety (SH) or carbodiimide (COOH). In addition, peptides can be conformationally constrained by, for example, incorporation of C_α and N_α-methylamino acids, introduction of double bonds between C_α and C_β atoms of amino acids and the formation of cyclic peptides or analogues by introducing covalent bonds such as forming an amide bond between the N and C termini, between two side chains or between a side chain and the N or C terminus.

The invention also extends to use of the peptides, or derivatives thereof of the present invention in the treatment of patients. In this latter aspect, such methods of treatment include their use as an adsorbent to remove autoantibodies or autoreactive cells from a patient, their use in direct administration to a patient as a means of desensitising or inducing immunological tolerance or other mechanisms to eliminate or diminish

reactivity of autoreactive T-cells or autoantibodies to IDDM autoantigens or to generate T-cell lines or clones to be used for or as therapeutic agents.

According to this aspect of the present invention, there is provided a method of treatment comprising administering to a subject an effective amount of a peptide or chemical equivalent thereof for a time and under conditions sufficient to remove or substantially reduce the presence or function in said subject of autoreactive T-cells and/or autoantibodies to IDDM autoantigens wherein the peptide comprises the formula:

$$X_1X_2X_3$$

wherein:

X_1 and X_3 may be the same or different and each is an amino acid sequence comprising from 0 to 40 naturally or non-naturally occurring amino acid residues;

X_2 is any amino acid sequence of from 10 to 100 residues derived from, homologous to or contiguous within amino acids 506 to 518 inclusive or derivatives thereof of human GAD65 and/or amino acids 24 to 36 inclusive or derivatives thereof of human proinsulin; and wherein said peptide molecule is capable of reacting with T cells and modifying T-cell function when incubated with cells from subjects having clinical or pre-clinical Insulin-Dependent Diabetes Mellitus (IDDM). Preferred cells include but are not limited to peripheral blood mononuclear cells (PBMCs), anticoagulated whole blood and tissue biopsy cells.

The method of treatment contemplated herein includes, but is not limited to, the following examples. A first example of treatment is desensitisation or tolerance induction using an effective amount of synthetic peptide or derivative thereof to alter T-cell recognition of or response to GAD and/or pro-insulin and/or other IDDM antigens and/or induce T-cell suppression or regulation. This may be achieved by using the known effect of certain ultraviolet wavelengths, especially UV-B, to modify antigen presentation through the skin or transmucosal or systemic administration. Effective amounts of the peptides or derivatives thereof would be applied epicutaneously to the skin of subjects exhibiting peripheral blood T-cell reactivity to GAD or proinsulin peptides or polypeptides. After exposure of skin to UV-B

radiation, treatment would be repeated until such time that T-cell reactivity to GAD or proinsulin was suppressed.

A second example of treatment is to induce mucosal-mediated tolerance using an effective amount of the subject peptides or derivatives thereof to alter T-cell recognition of or response to GAD and/or pro-insulin and/or other IDDM antigens and/or induce T-cell suppression using an effective amount of peptide or derivative thereof to alter T-cell recognition of or response to GAD and/or pro-insulin and/or other IDDM antigens and/or induce T-cell suppression by the administration of the peptide or derivatives thereof by oral, aerosol or intranasal means amongst other routes of mucosal administration.

Another treatment involves application of the subject peptides to the skin together with one or more cytokines such as but not limited to TNFα or β. A further treatment involves systemic administration of soluble peptide via subcutaneous or intravenous routes to induce immunological tolerance. Yet another treatment involves T-cell immunisation whereby T-cell lines are generated to GAD or proinsulin peptide or polypeptide or fragments thereof by standard procedures, cells attenuated by fixation with agents such as glutaraldehyde or paraformaldehyde, washed under sterile conditions and re-injected into patients for a time and under conditions to cause suppression of the endogenous T-cell response to autoantigens. These approaches are applicable to the prevention of IDDM progression in asymptomatic subjects with pre-clinical IDDM or subjects with recent - onset clinical IDDM, as well as to the recurrence of IDDM in subjects who have received pancreas, islet cell or insulin-producing cell transplants. These approaches are also applicable to Stiff Man Syndrome (SMS) and other diseases where GAD and/or proinsulin is an autoantigen.

In accordance with the present invention, the effective amount of peptide is 0.1 μg to 10 mg per dose and preferably 1.0 μg to 1 mg per dose. A dose may comprise a single administration or protocol comprising single or multiple administration hourly, daily, weekly or monthly or at other suitable times. Administration may be by any

convenient means such as, but not limited to, intravenous, subcutaneous, epicutaneous, infusion, oral, topical, intranansal, aerosol suppository or intraperitoneal administration. The peptide may be administered alone or in combination with one or more other active molecules such as molecules which facilitate the activity or action of the peptide for example lipopolysaccharide (LPS), choleratoxin β-chain, Lymphocyte Functional Associated Antigen-3 (LFA-3), other adjuvants and in particular, tumour necrosis factor α (TNF-*α*), tumour necrosis factor β (TNF-*β*) or leukaemia inhibitory factor (LIF).

In yet a further embodiment, the present invention contemplates the use of the peptides described herein to measure reactivity of a subject's cells to the IDDM autoantigen. The peptides or derivatives thereof may be added in solution or bound to a solid support together with cells derived from peripheral blood or from tissue biopsies either unfractionated, fractionated or derived as continuous cell lines. Reactivity to the autoantigen may then be measured by standard proliferation assays such as incorporation of tritiated thymidine, standard cytotoxic assays such as release of marker radioactivity from target cells, measurements of expressed or secreted molecules such as surface markers, cytokines or other standard assays of cellular reactivity which are well known in the art.

According to this aspect of the present invention, there is provided a method of assaying the reactivity of a subject to IDDM autoantigen, said method comprising contacting a peptide or chemical equivalent thereof comprising the formula:

$$X_1X_2X_3$$

wherein:

X_1 and X_3 may be the same or different and each is an amino acid sequence comprising from 0 to 40 naturally or non-naturally occurring amino acid residues;

X_2 is any amino acid sequence of from 10 to 100 residues derived from, homologous to or contiguous within amino acids 506 to 518 inclusive or derivatives thereof of human GAD65 and/or amino acids 24 to 36 inclusive or derivatives thereof of human proinsulin; and wherein said peptide molecule is capable of reacting with T cells and modifying T-cell function when incubated with cells from subjects having pre-clinical

or clinical Insulin-Dependent Diabetes Mellitus (IDDM) and determining reactivity by appropriate assay. In accordance with this assay, any cell type may be used but is preferably selected from PBMC's, anti-coagulated whole blood cells or tissue biopsy cells.

Preferably, the present invention contemplates a method of assaying the reactivity of a subject to IDDM autoantigen said method comprising contacting a peptide or chemical equivalent thereof comprising the formula:

$$X_1X_2X_3$$

wherein:

X_1 and X_2 may be the same or different and each is an amino acid sequence comprising from 0 to 15 naturally or non-naturally occurring amino acid residues; X_2 is selected from FFYTPKTRREAED and FWYIPPSLRTLED or a derivative or chemical equivalent thereof and wherein said peptide is capable of reacting with T cells and modifying T-cell function when incubated with cells from subjects with pre-clinical or clinical IDDM and determining reactivity by an appropriate assay. Preferably, cells include but are not limited to peripheral blood mononuclear cells (PBMCs), anticoagulated whole blood and tissue biopsy cells.

In another embodiment of the present invention, there is provided a diagnostic kit for assaying T cells. Standard 96 - well plates, as used in ELISA, are pre-coated with a monoclonal antibody (MAb) to a T-cell cytokine such as γ-interferon (γ-IFN) with or without antigen. Alternatively, antigen is added in soluble form together with aliquots of peripheral blood, peripheral blood mononuclear cells or T-cells. Incubation is allowed to proceed for one or more days, the supernatant (comprising medium and plasma) and the cells are washed off, wells washed again and plates developed with a labelled second MAb to the cytokine such as anti-γ-IFN conjugated with alkaline phosphatase or horseradish peroxidase. Colorimetric reaction and read-out systems can then be utilised. Alternatively, soluble cytokines (eg: γ-IFN) are measured in the supernatant by standard assays such as ELISA; further it is possible to visualise microscopically by the ELISPOT technique individual spots on bottoms of wells representing cytokine produced at the single cell level thereby enabling the

frequency of peptide- epitope-reactive T-cells to be determined.

The present invention will now be further described with reference to the following non-limiting Figures and Examples.

In the Figures:

Figure 1 shows a comparison of the regions of similarity among mouse and human proinsulins and GADs. Similarities are boxed; identities within boxes are shaded. The C-terminus of the mature insulin B-chain and the pro-insulin cleavage site are indicated by the vertical line and arrow respectively.

Figure 2 is a graphical representation showing the level of cellular proliferation expressed as the delta score following the stimulation of peripheral blood mononuclear cells taken from IDDM at-risk (as described in Example 1) or control subjects with the following peptides: human GAD65 (residues 506-518); human proinsulin (residues 24-36); irrelevant control peptide; or tetanus toxoid (CSL Ltd., Melbourne, Australia).

Figure 3 is a graphical representation showing proliferation (mean + sem) of pbmc to proinsulin (aa 24-36) and insulin (aa 1-15) in pre-clinical and control subjects.

Figure 4 is a graphical representation showing IFN-gamma response (mean + sem) to proinsulin (aa 24-36) and insulin beta chain (aa 1-15) in pre-clinical and control subjects.

Figure 5 is a graphical representation showing IL10 response (mean + sem) to proinsulin (aa 24-36) and insulin beta-chain (aa 1-15) in pre-clinical and control subjects.

The following single and three letter abbreviations are used for amino acid residues:

Amino Acid	Three-letter Abbreviation	One-letter Symbol
Alanine	Ala	A
Arginine	Arg	R
Asparagine	Asn	N
Aspartic acid	Asp	D
Cysteine	Cys	C
Glutamine	Gln	Q
Glutamic acid	Glu	E
Glycine	Gly	G
Histidine	His	H
Isoleucine	Ile	I
Leucine	Leu	L
Lysine	Lys	K
Methionine	Met	M
Phenylalanine	Phe	F
Proline	Pro	P
Serine	Ser	S
Threonine	Thr	T
Tryptophan	Trp	W
Tyrosine	Tyr	Y
Valine	Val	V
Any residue	Xaa	X

EXAMPLE 1

Subjects

Subjects at-risk for IDDM were from the Melbourne Prediabetes Family Study, Victoria, Australia. Each was entered on the basis of having at least one first degree relative with IDDM and islet cell antibodies (ICA)≥20 JDF units and/or insulin autoantibodies (IAA)≥100nU/ml. All had normal fasting blood glucose and glycated hemoglobin and had had repeat antibody and metabolic tests at six monthly intervals.

Control subjects were HLA-DR matched, asymptomatic, and without history of IDDM.

All subjects gave informed, signed consent and the study was approved by the Ethics Committees of the Royal Melbourne Hospital and the Walter and Eliza Hall Institute of Medical Research. Details of Subjects are described in Table 1.

EXAMPLE 2

HLA typing and assays of ICA, IAA, GAD Ab, FPIR:

HLA Typing:

HLA class I (A, B, C) and HLA class II (DR,DQ) typing was performed using populations of T and B lymphocytes respectively. The cells were isolated from anticoagulated blood using magnetic beads (Dynal) coated with monoclonal antibodies to CD8 (class I) or a monomorphic determinant on the class II beta chain (class II). The enriched cell populations were typed in a standard microlymphocytotoxicity assay using a battery of 240 allosera for class I and 120 allosera for class II.

Antibody assays:

ICA were assayed using indirect immunofluorescence on blood group O donor pancreas. Titres, in JDF units, were determined by doubling dilution of positive sera

and comparison with standard sera run in each assay. The assay has been included in all International Diabetes Workshops and proficiency programs.

IAA were assayed by a radiobinding assay which has been internationally standardised. The upper limit for normal control sera is 40 nU insulin bound/ml serum.

GAD antibodies were assayed by immunoprecipitation of GAD enzymatic activity from piglet brain extract . The mean plus (three) 3 SD of 72 healthy subjects, 460nU/ml, was used to define the normal range.

First phase insulin release (FPIR):

FPIR was calculated as the sum of serum insulin concentrations at 1 and 3 minutes following the completion of intravenous glucose (0.5g/kg body weight) injected over 3 minutes.

EXAMPLE 3

T-cell proliferation assay

Blood was drawn from paired IDDM at-risk and HLA-DR matched controls at the same time (within 30 minutes) and processed similarly to reduce the effects of diurnal variation and handling artefacts. Peripheral blood mononuclear cells were isolated from heparinised whole blood by Ficoll-Paque (Pharmacia Biotech) density centrifugation, washed and resuspended in RPMI 1640 medium (Biosciences Pty Ltd) containing 20mM Hepes (CSL Ltd), 10^{-5} M 2-mercaptoethanol (BDH), penicillin (100U/ml), streptomycin (100μg/ml) and 10% v/v autologous plasma. Aliquots of 200μl ($2x10^5$ cells) were transferred into wells of a 96-well, round-bottomed plate (Falcon) and incubated in replicates of six with the following peptides at final concentrations of 10, 2, and 0.4μg/ml: human GAD65 (506-518), human proinsulin (24-36) (synthesised using an Applied Biosystems Model 431A synthesiser (ABI, Foster city, CA), and an irrelevant control peptide (CRFDPQFALTNIAVRK) (Macromolecular Resources, Fort Collins, CO). Tetanus toxoid (CSL Ltd,

Melbourne, Australia) at final concentrations of 1.8, 0.18 and 0.018 LfU/ml was used as a positive control. Twelve "autologous only" wells containing cells but without antigen were included as the background control. Plates were incubated at 37°C in a 5% v/v CO_2 humidified incubator for 6 days; 0.25μCi of [^{3}H]thymidine (ICN) was added to each well for the last 6 hours. The cells were than harvested onto glass fibre filters and incorporated radioactivity measured by beta-particle counting (Packard Model 2000 Liquid Scintillation Counter). The level of cellular proliferation was expressed as the delta score (DS=mean counts per minute (cpm) incorporated in the presence of antigen, minus the mean cpm of the "autologous only" wells).

EXAMPLE 4

T-cell Proliferative Responses

T-cell proliferative responses to the similar 13-mer peptides from proinsulin and GAD were compared for ten pairs of HLA-DR matched at-risk and control subjects. HLA-DR matching was thought to be important not only because of the specificity of peptide binding to MHC class II alleles but also because of the known association between MHC class II and IDDM. Therefore, T-cell responses would reflect IDDM rather than MHC specificity . Responses to the highest concentration of either peptide were significantly (proinsulin, $p<0.008$; GAD, $p<0.018$ - Wilcoxon one-tailed paired analysis) greater among IDDM at-risk than control subjects. The results are summarised in Table 2.

Reactivity to the proinsulin sequence was confined almost entirely to IDDM at-risk subjects, whereas some controls also responded to the GAD peptide (Table 2, Fig. 2). Both groups responded similarly to tetanus, and no subject reacted to the unrelated control peptide.

For six of these pairs (#1, 2, 3, 5, 6, 7) the assay was performed on a separate occasion, but using twice as many cells ($4x10^5$ per well). Exhaustion of the media resulted in unreliable results in three cases. In two of the other three (#5 and 6), the

results were consistent with those tabulated here, while in the third (#3) the at-risk subject displayed greater reactivity to both antigens at the higher cell number.

EXAMPLE 5

T-cell cytokine secretion assays

In a second cohort of 18 paired IDDM at-risk and HLA-DR-matched controls, PBMCs indicated as per Example 3 were incubated with human proinsulin 24-36 and human insulin B chain 1-15 each at 0.5, 5 and 50 μg/ml under the conditions as per Example 3. In addition to harvesting cells for the measurement of proliferation by [^{3}H] thymidine uptake after 6 days, as per Example 3, incubation media above the cells was sampled after 2 days for the measurement of IFN-γ and interleukin-(IL-) 10 by standard ELISA methods.

EXAMPLE 6

T-Cell Responses

T-cell proliferative and IFN-γ and IL-10 secretory responses to human proinsulin 24-36 and human insulin B 1-15 were compared for 18 pairs of HLA-DR matched IDDM at-risk and control subjects. As per Example 4, there was a significantly greater ($p=0.003$) proliferative response of IDDM at-risk subjects to the proinsulin peptide (Figure 3). In addition, both IFN-γ and IL-10 secretion in response to the proinsulin peptide were significantly increased ($p=0.005$ and $p=0.001$, respectively) compared to matched control subjects (Figures 4, 5).

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. It is to be understood that the invention includes all such variations and modifications. The invention also includes all of the steps, features, compositions and compounds referred to or indicated in this specification, individually or collectively, and any and all combinations of any two or more of said steps or features.

Table 1

Subject #	Age	Years Follow-up	HLA				ICA *
			A	B	DR	DQ	
1	14	1.6	1	8	3	2	160,69,56
2	23	4.8	2	44,55	3,4	5,8	55,37,14,6,5,5
3	22	6.8	2,28	7,8	3,4	2,8	37,37,37,37,52,30,58,46,26
4	13	1.3	1,11	8,27	3,4	2,8	160,190
5	25	5.5	2	44,62	4,11	7,8	0,19,18,16,22,0,0
6	20	5.5	1,2	8,62	3,4	2,8	19.19.104.86.8
7	18	1.7	1,3	8,18	3	2	69,69
8	9	3.2	1,2	8,44	3,4	2,8	160,160,160,160
9	10	2.8	1,2	8,27	3,4	2,8	160,160,120,24
10	14	4.8	1,32	8,14	4,7	2,8	14,13,51,18

(Continued...)

Table 1 (...continued)

Subject #	Age	Years Follow-up	IAA †	GAD Ab £	FPIR ¶
1	14	1.6	4,30,-20		118,155
2	23	4.8	-25,9,41,-2,0,44	278,602	124,113,57
3	22	6.8	8,9,2,31,7,9,-41,-1,64	1637,2259,634,1535	183,155,140,161,56
4	13	1.3	84.280		79,91
5	25	5.5	45,31,42,60,29,130,30	736,936,1336,790,810	137,143,68,15
6	20	5.5	480,560,400,130,300	937,2258,2389	105,238,165,128
7	18	1.7	13,20		44,47
8	9	3.2	-2,-26,36,59	2300,1830	118,129,87
9	10	2.8	2,29,14,120	1525,1388	26,56,29
10	14	4.8	240,490,470,1000	432	318,181,165

* ICA=islet cell antibody titres (JDF units)
† IAA=insulin autoantibody titres (nU insulin bound/ml serum)
£ GADAb=glutamic acid decarboxylase autoantibody titres (nU/ml)
¶ FPIR=first phase insulin release (sum of serum insulin concentrations at 1 and 3 minutes following completion of glucose injection)

Table 2

Pair #		Delta Scores*							
		Autologous		Proinsulin 10 µg/ml		Proinsulin 2 µg/ml		Proinsulin 0.4 µg/ml	
		At Risk	*Control*	*At Risk*	*Control*	*At Risk*	*Control*	*At Risk*	*Control*
1		881	2979	1391	0	459	0	1040	0
2		236	389	351	0	0	0	33	0
3		6515	217	0	64	355	43	0	0
4		595	1347	104	0	0	0	288	0
5		1745	1269	694	0	0	0	0	0
6		1007	265	397	98	65	380	0	0
7		1392	454	467	93	0	0	0	0
8		9993	308	2128	0	1367	0	0	0
9		598	135	0	0	265	13	0	0
10		597	870	56	21	0	22	0	0
	Mean	2355.8	823.4	558.7	27.6	251.1	45.8	136.0	0
	Std. Error	1025.7	276.2	219.5	13.0	135.3	37.4	104.4	0
	Wilcoxon P-Value (One-Tailed)			0.008		0.125		0.054	

(Continued...)

Table 2 (...continued)

Pair #		Delta Scores*					
		GAD 10 µg/ml		GAD 2 µg/ml		GAD 0.4 µg/ml	
		At Risk	*Control*	*At Risk*	*Control*	*At Risk*	*Control*
1		579	0	516	0	768	0
2		3263	0	190	0	199	0
3		0	77	0	5	0	25
4		0	0	10	0	0	0
5		1275	20	394	120	53	30
6		1679	992	220	216	77	195
7		2313	1365	0	0	0	70
8		0	0	0	0	0	0
9		1251	337	0	0	255	21
10		65	391	0	1441	0	0
	Mean	1042.4	318.1	133.0	178.2	135.3	34.1
	Std. Error	357.1	153.0	60.5	142.2	76.0	19.2
	Wilcoxon P-Value (One-Tailed)	0.018		0.199		0.199	

* Delta Score=mean of six replicate wells minus mean of twelve autologous wells (if less than 0, shown as 0)

SEQUENCE LISTING

(1) GENERAL INFORMATION:

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(B) COMPUTER: IBM PC compatible
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(B) FILING DATE: 04-SEP-1995

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(2) INFORMATION FOR SEQ ID NO:1:

(i) SEQUENCE CHARACTERISTICS:
(A) LENGTH: 13 amino acids
(B) TYPE: amino acid
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:1:

Phe Phe Tyr Thr Pro Lys Thr Arg Arg Glu Ala Glu Asp
5 10

(2) INFORMATION FOR SEQ ID NO:2:

(i) SEQUENCE CHARACTERISTICS:
(A) LENGTH: 13 amino acids
(B) TYPE: amino acid
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:2:

Phe Trp Tyr Ile Pro Pro Ser Leu Arg Thr Leu Glu Asp
5 10

CLAIMS:

1. A recombinant or synthetic peptide or chemical equivalent thereof comprising the formula:

$$X_1X_2X_3$$

wherein:

X_1 and X_3 may be the same or different and each is an amino acid sequence comprising from 0 to 40 naturally or non-naturally occurring amino acid residues;

X_2 is any amino acid sequence of from 10 to 100 residues derived from, homologous to or contiguous within amino acids 506 to 518 inclusive or derivatives thereof of human GAD65 and/or amino acids 24 to 36 inclusive or derivatives thereof of human proinsulin; and wherein said peptide molecule is capable of reacting with T cells and modifying T-cell function when incubated with cells from subjects with pre-clinical or clinical Insulin-Dependent Diabetes Mellitus (IDDM).

2. A peptide molecule according to claim 1 wherein X_2 comprises from 10 to 50 amino acid residues.

3. A peptide molecule according to claim 2 wherein X_2 comprises from 10 to 30 amino acid residues.

4. A peptide molecule according to claim 3 wherein X_2 comprises from 10 to 15 amino acid residues.

5. A peptide molecule according to claim 1 or 2 or 3 or 4 wherein X_2 comprises the amino acid sequence: FFYTPKTRREAED.

6. A peptide molecule according to claim 1 or 2 or 3 or 4 wherein X_2 comprises the amino acid sequence: FWYIPPSLRTLED.

7. A recombinant or synthetic peptide or chemical equivalent thereof comprising the sequence:

$$X_1X_2X_3$$

wherein:

X_1 and X_2 may be the same or different and each is an amino acid sequence comprising from 0 to 15 naturally or non-naturally occurring amino acid residues;

X_2 is selected from FFYTPKTRREAED and FWYIPPSLRTLED or a derivative or chemical equivalent thereof and wherein said peptide is capable of reacting with T cells and modifying T-cell function when incubated with cells from subjects having pre-clinical or clinical IDDM.

8. A method of assaying the reactivity of a subject to IDDM autoantigen said method comprising contacting a peptide or chemical equivalent thereof comprising the formula:

$$X_1X_2X_3$$

wherein:

X_1 and X_3 may be the same or different and each is an amino acid sequence comprising from 0 to 40 naturally or non-naturally occurring amino acid residues;

X_2 is any amino acid sequence of from 10 to 100 residues derived from, homologous to or contiguous within amino acids 506 to 518 inclusive or derivatives thereof of human GAD65 and/or amino acids 24 to 36 inclusive or derivatives thereof of human proinsulin; and wherein said peptide molecule is capable of reacting with T cells and modifying T-cell function when incubated with cells from subjects having pre-clinical or clinical Insulin-Dependent Diabetes Mellitus (IDDM) with cells from said subject and determining reactivity by an appropriate assay.

9. A method according to claim 8 wherein the cells are selected from the group comprising PBMCs, anti-coagulated whole blood and/or tissue biopsy cells.

10. A method according to claim 8 or 9 wherein an appropriate assay includes proliferation assay, cytotoxic assays, celular reactivity or combination thereof.

11. A method according to claim 8 wherein X_2 comprises from 10 to 50 amino acid residues.

12. A method according to claim 11 wherein X_2 comprises from 10 to 30 amino acid residues.

13. A method according to claim 12 wherein X_2 comprises from 10 to 15 amino acid residues.

14. A method according to claim 8 or 9 or 10 or 11 or 12 wherein X_2 comprises the amino acid sequence: FFYTPKTRREAED.

15. A method according to claim 8 or 9 or 10 or 11 or 12 wherein X_2 comprises the amino acid sequence: FWYIPPSLRTLED.

16. A method of assaying the reactivity of a subject to IDDM autoantigen said method comprising contacting a peptide or chemical equivalent thereof comprising the formula:

$$X_1X_2X_3$$

wherein:

X_1 and X_2 may be the same or different and each is an amino acid sequence comprising from 0 to 15 naturally or non-naturally occurring amino acid residues;

X_2 is selected from FFYTPKTRREAED and FWYIPPSLRTLED or a derivative or chemical equivalent thereof and wherein said peptide is capable of reacting with T cells and modifying T-cell function when incubated with cells from subjects with pre-clinical or clinical IDDM with cells from said subject and determining reactivity by an appropriate assay.

17. A method according to claim 16 wherein the cells are selected from the group comprising PBMCs, anti-coagulated whole blood and/or tissue biopsy cells.

18. A method according to claim 16 or 17 wherein an appropriate assay includes proliferation assay, cytotoxic assays, celular reactivity or combination thereof.

19. Use of a peptide or chemical equivalent thereof comprising the formula:

$$X_1X_2X_3$$

wherein:

X_1 and X_3 may be the same or different and each is an amino acid sequence comprising from 0 to 40 naturally or non-naturally occurring amino acid residues;

X_2 is any amino acid sequence of from 10 to 100 residues derived from, homologous to or contiguous within amino acids 506 to 518 inclusive or derivatives thereof of human GAD65 and/or amino acids 24 to 36 inclusive or derivatives thereof of human proinsulin; and wherein said peptide molecule is capable of reacting with T cells and modifying T-cell function when incubated with cells from subjects having pre-clinical or clinical Insulin-Dependent Diabetes Mellitus (IDDM) to assay reactivity of a subject to IDDM autoantigen by contacting said peptide or its chemical equivalent to cells from said subject and determining reactivity by an appropriate assay.

20. Use according to claim 19 wherein the cells are selected from the group comprising PBMCs, anti-coagulated whole blood and/or tissue biopsy cells.

21. Use according to claim 19 or 20 wherein an appropriate assay includes proliferation assay, cytotoxic assays, celular reactivity or combination thereof.

22. Use according to claim 19 wherein X_2 comprises from 10 to 50 amino acid residues.

23. Use according to claim 22 wherein X_2 comprises from 10 to 30 amino acid residues.

24. Use according to claim 23 wherein X_2 comprises from 10 to 15 amino acid residues.

25. Use according to claim 19 or 20 or 21 or 22 or 23 or 24 wherein X_2 comprises the amino acid sequence: FFYTPKTRREAED.

26. Use according to claim 19 or 20 or 21 or 22 or 23 or 24 wherein X_2 comprises the amino acid sequence: FWYIPPSLRTLED.

27. Use of a peptide or chemical equivalent thereof comprising the formula:

$$X_1X_2X_3$$

wherein:

X_1 and X_2 may be the same or different and each is an amino acid sequence comprising from 0 to 15 naturally or non-naturally occurring amino acid residues; X_2 is selected from FFYTPKTRREAED and FWYIPPSLRTLED or a derivative or chemical equivalent thereof and wherein said peptide is capable of reacting with T cells and modifying T-cell function when incubated with cells from subjects with pre-clinical or clinical IDDM to assay reactivity of a subject to IDDM autoantigen by contacting said peptide or its chemical equivalent with cells from said subject and determining reactivity by a proliferation assay.

28. Use of a peptide or chemical equivalent according to claim 27 wherein the cells are selected from the group comprising PBMCs, anti-coagulated whole blood and/or tissue biopsy cells.

29. Use of a peptide or chemical equivalent according to claim 27 or 28 wherein an appropriate assay includes proliferation assay, cytotoxic assays, celular reactivity or combination thereof.

30. A method of treatment comprising administering to a subject an effective amount of a peptide or chemical equivalent thereof for a time and under conditions sufficient to remove or substantially reduce the presence in said subject of autoreactive T-cells and/or autoantibodies to IDDM autoantigens wherein the peptide comprises the formula:

$$X_1X_2X_3$$

wherein:

X_1 and X_3 may be the same or different and each is an amino acid sequence comprising from 0 to 40 naturally or non-naturally occurring amino acid residues; X_2 is any amino acid sequence of from 10 to 100 residues derived from, homologous to or contiguous within amino acids 506 to 518 inclusive or derivatives thereof of human GAD65 and/or amino acids 24 to 36 inclusive or derivatives thereof of human proinsulin; and wherein said peptide molecule is capable of reacting or modifying T-cell function when incubated with cells from subjects having pre-clinical or clinical Insulin-Dependent Diabetes Mellitus (IDDM).

31. A method according to claim 30 wherein X_2 comprises from 10 to 50 amino acid residues.

32. A method according to claim 31 wherein X_2 comprises from 10 to 30 amino acid residues.

33. A method according to claim 32 wherein X_2 comprises from 10 to 15 amino acid residues.

34. A method according to claim 30 or 31 or 32 or 33 wherein X_2 comprises the amino acid sequence: FFYTPKTRREAED.

35. A method according to claim 30 or 31 or 32 or 33 wherein X_2 comprises the amino acid sequence: FWYIPPSLRTLED.

36. A pharmaceutical composition comprising a recombinant peptide or equivalent thereof according to claim 1 or 7 and one or more pharmaceutically acceptable carriers and/or diluents.

ABSTRACT

The present invention relates generally to molecules such as peptides, polypeptides and proteins which interact immunologically with antibodies or T-cells in subjects having pre-clinical or clinical Insulin-Dependent Diabetes Mellitus (IDDM). These molecules are preferentially immunoreactive to T-cells in subjects having pre-clinical or clinical IDDM and are useful in the development of diagnostic, therapeutic and prophylactic agents for IDDM.

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY
(Includes Reference to PCT International Applications)

ATTORNEY'S DOCKET NUMBER
10308

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

IMMUNOREACTIVE AND IMMUNOTHERAPEUTIC MOLECULES

the specification of which (check only one item below):

☐ is attached hereto.

☒ was filed as United States application

Serial No. 08/663,272

on 18 June 1996,

and was amended

on _____ (if applicable).

☐ was filed as PCT international application

Number PCT/AU96/00085

on 20 February 1996,

and was amended under PCT Article 19

on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowlege the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (if PCT, indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
Australia	PN 1239/95	20 February 1995	☒ YES ☐ NO
Australia	PN 5172/95	4 September 1995	☒ YES ☐ NO
International	PCT/AU96/00085	20 February 1996	☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO

Combined Declaration For Patent Application and Power of Attorney (Continued)
(Includes Reference to PCT International Applications)

ATTORNEY'S DOCKET NUMBER 10308

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowlege the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS (Check one)		
U S APPLICATION NUMBER	U S FILING DATE	PATENTED	PENDING	ABANDONED
PCT APPLICATIONS DESIGNATING THE U.S.				
PCT APPLICATION NO	PCT FILING DATE	U S SERIAL NUMBERS ASSIGNED (if any)		

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. Stephen D. Murphy, Reg. No. 22,002; Leopold Presser, Reg. No. 19,827; William C. Roch, Reg. No. 24,972; Kenneth L. King, Reg. No. 24,223; Frank S. DiGiglio, Reg. No. 31,346; Paul J. Esatto, Jr., Reg. No. 30,749; John S. Sensny, Reg. No. 28,757; Mark J. Cohen, Reg. No. 32,211; Richard L. Catania, Reg. No. 32,608 and Donald T. Black, Reg. No. 27,999.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
x LH	x MH	x GR
DATE x 17/10/96	DATE x 9/10/96	DATE x 16/10/96

[X] Signature for fourth and subsequent joint inventors.
Number of pages added 1.

Docket: 10308

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	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 204 x Andrew M. Lew	SIGNATURE OF INVENTOR 205	SIGNATURE OF INVENTOR 206
DATE x 9/10/96	DATE	DATE
SIGNATURE OF INVENTOR 207	SIGNATURE OF INVENTOR 208	SIGNATURE OF INVENTOR 209
DATE	DATE	DATE

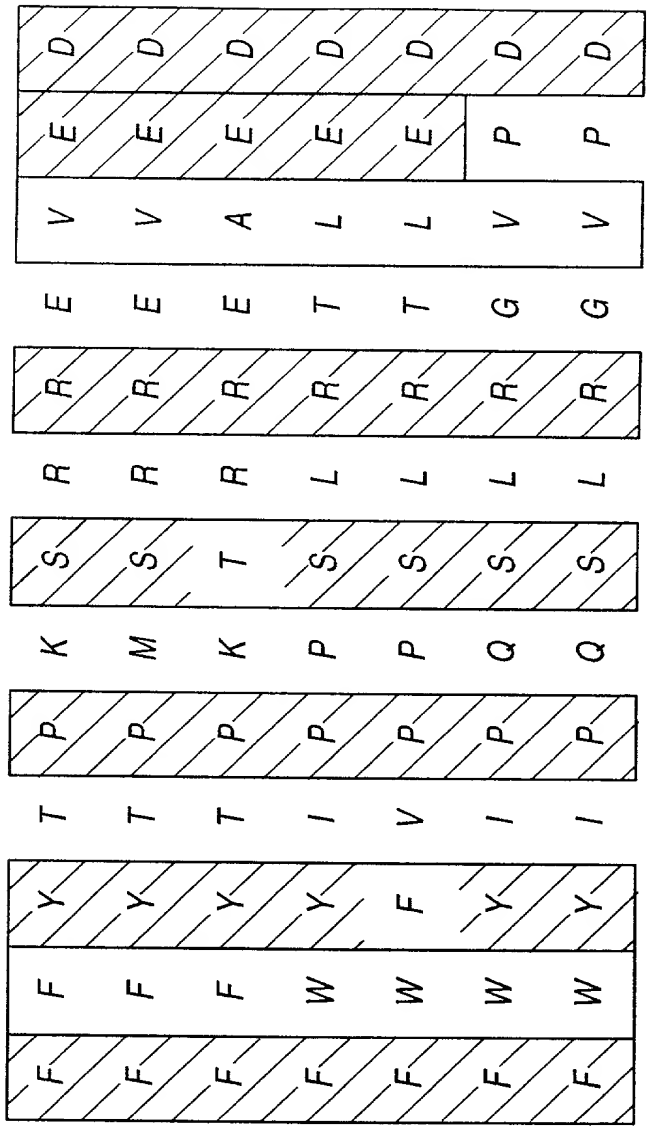

Fig. 1

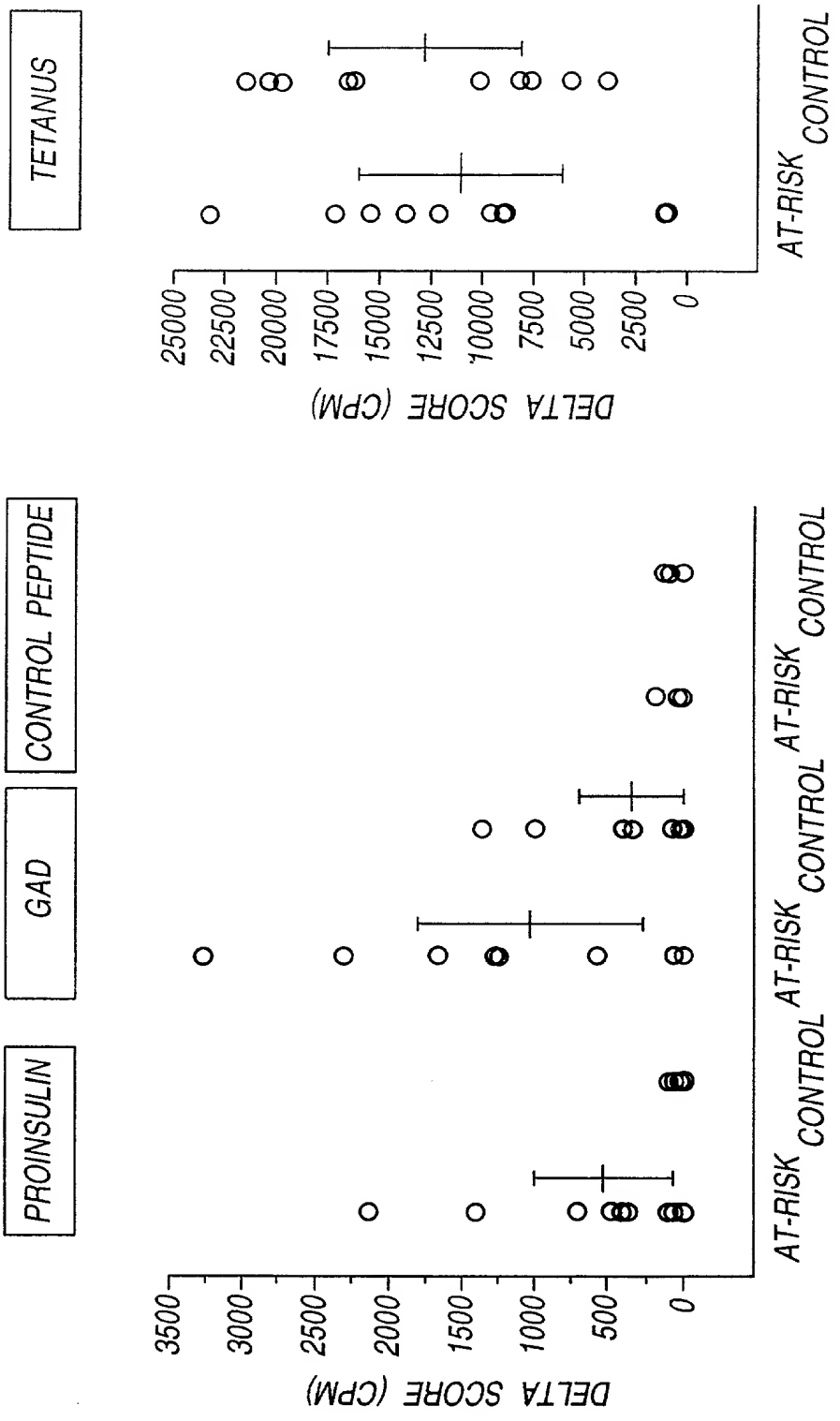

Fig. 2

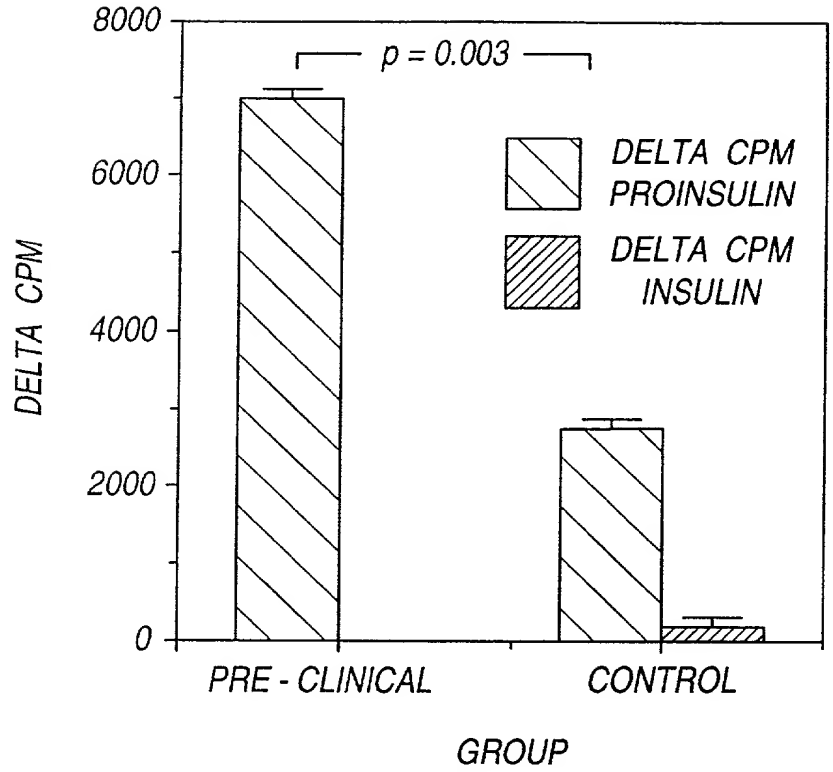

Fig . 3

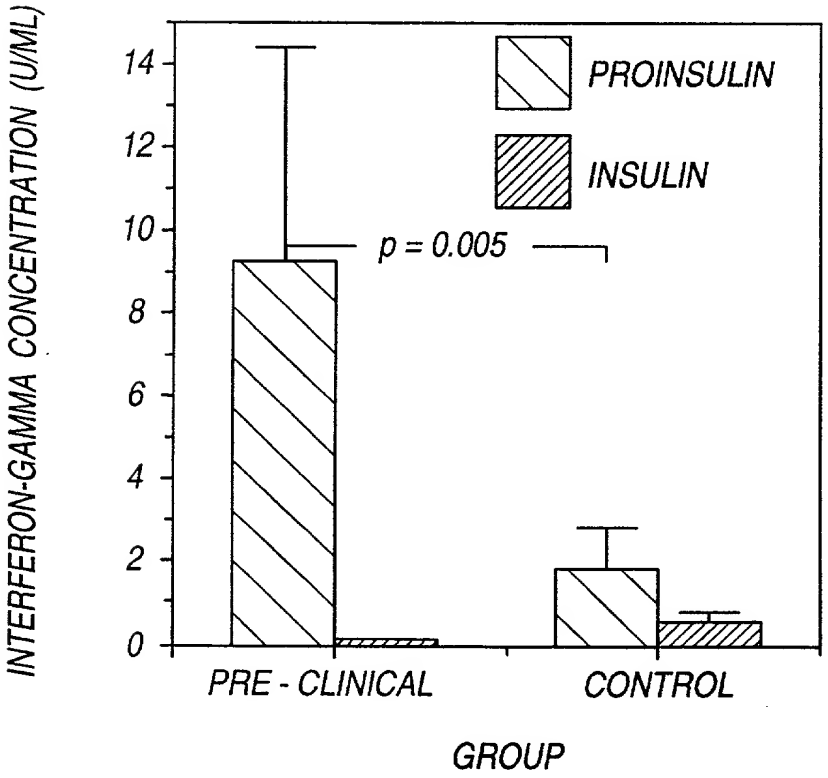

Fig . 4

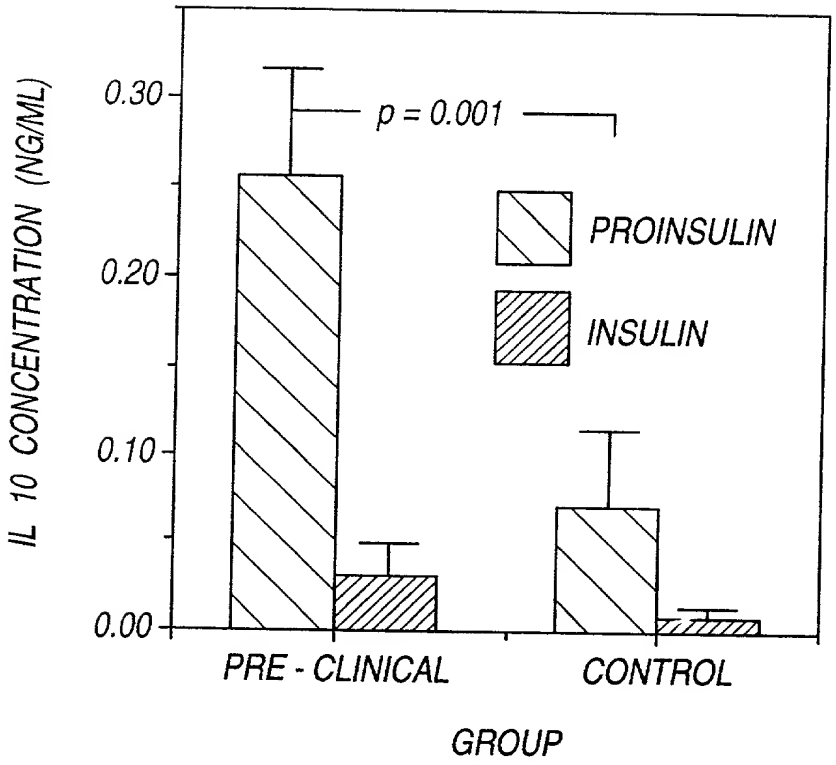

Fig . 5